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DOCKET NO. E-00000D-09-0020

NOTICE OF FILING

Tucson Electric Power Company, through undersigned counsel, hereby files its Reliability Must-Run Generation Report.

RESPECTFULLY SUBMITTED this 26th day of February 2010.

TUCSON ELECTRIC POWER COMPANY

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Arizona Corporation Commission
DOCKETED
FEB 26 2010

DOCKETED BY

Original and 13 copies of the foregoing
filed this 26th day of February 2010 with:

Docket Control
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1200 West Washington Street
Phoenix, Arizona 85007

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TEP

Tucson Electric Power

A UniSource Energy Company

A STUDY OF SIMULTANEOUS IMPORT LIMIT, RELIABILITY MUST-RUN GENERATION, MAXIMUM LOAD SERVING CAPABILITY, COMMON CORRIDOR OUTAGES & EXTREME CONTINGENCIES

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Background

Every two years the Arizona Corporation Commission ("Commission") requires Arizona utilities to study their electrical power systems at various system conditions in accordance with applicable North American Electric Reliability Corporation ("NERC") Reliability Standards or Western Electricity Coordinating Council ("WECC") System Performance Criteria. The system conditions for the study consist of simultaneous import limit ("SIL"), maximum load serving capability ("MLSC"), reliability must-run generation ("RMR"), common corridor ("CC") outages, and extreme contingencies ("EC") for specific years. The Commission also requests information on environmental outputs, generator and generation sensitivity, transmission import limit, and alternative solutions.

Purpose and Scope

The purpose of this study was to assess Tucson Electric Power's ("TEP") electrical power system under a variety of system conditions required by the Commission based on WECC/NERC reliability criteria (pre and post contingency criteria). The scope of this report is as follows:

- SIL for 2010, 2013, and 2019;
- MLSC for 2010, 2013, and 2019;
- RMR for 2013 and 2019;
- CC outages for 2010;
- EC for 2010;
- A comparison of 2010 SIL remote generation and projected transmission ownership/scheduling rights; and
- Cost estimates of running RMR generation, purchasing equivalent energy from market resources and necessary upgrades to eliminate RMR.

Conclusions

The following conclusions, shown in Table 1, result from this study.

- TEP can serve loads and meet WECC/NERC reliability criteria under the system conditions of SIL, MLSC, and Peak/RMR.
- TEP can survive double contingencies involving parallel lines in the Springerville to Vail corridor under the 2010 system conditions.
- TEP can survive loss of all transformers at any given extra high voltage ("EHV") substation under the 2010 system conditions.
- It is not economically justifiable to upgrade the transmission system to eliminate RMR generation in 2013 and 2019 because the cost of doing so significantly outweighs the annual incremental cost of RMR generation.

Year	Peak Load Forecast (MW)	System Condition	Total System Condition Value (Load + Loss) (MW)	Limiting Outage	Limiting Element	Local Gen	Annual Incremental RMR Gen Cost Estimates	RMR Mitigation Cost Estimates
2010	2384	SIL	2239	Winchester – Vail 345 kV line	ΔV>5% at Kartchner 115 kV bus	N/A	N/A	N/A
		MLSC	2641	Saguaro – Tortolita #1 & #2 500 kV lines	DeMoss Petrie – Santa Cruz 138 kV line overload	546	N/A	N/A
2013	2527	SIL	1948	Winchester – Vail 345 kV line	ΔV>5% at Kartchner 115 kV bus	N/A	N/A	N/A
		MLSC	2638	Winchester – Vail 345 kV line	ΔV>5% at Kartchner 115 kV bus	546	N/A	N/A
		RMR	2592	Winchester – Vail 345 kV line	ΔV>5% at Kartchner 115 kV bus	430	$624,202	$156,568,000 - $197,609,321
2019	2792	SIL	2442	Pinal West –South & Vail – South 345 kV lines	ΔV>10% at Rosemont & Greater Ville 138 kV buses	N/A	N/A	N/A
		MLSC	3104	Pinal West –South & Vail – South 345 kV lines	Irvington – Drexel 138 kV overload	546	N/A	N/A
		RMR	2883	Springerville – Vail 345 kV line	North Loop – West Ina 138 kV line	30	$260,773	$1,455,000 - $3,375,600

Table 1. SIL, MLSC, and RMR for 2010, 2013, and 2019 and Cost Estimates of RMR Generation and Upgrades

Introduction

Background

In order to assess Arizona's electrical power systems in accordance with applicable NERC Reliability Standards or WECC System Performance Criteria, the Arizona Corporation Commission requires Arizona utilities to study their systems at SIL, MLSC, and Peak every two years. For the SIL, MLSC, and Peak evaluations, normal operating study procedures are followed. Common corridor outages and extreme contingencies (all transformers at any one EHV substation) are studied as well. RMR generation is determined for the Peak loads. Utilities are also required to provide information on the environmental outputs, generators and generation sensitivity, transmission import limit, and alternative solutions.

Purpose and Scope

The purpose of this report is to analyze the TEP system operating at SIL, MLSC, and Peak loads; to study the applicable contingencies in a clear and concise format; and to present the findings. The scope of the report involved evaluating TEP's system for the years 2010, 2013, and 2019. For each year the system was evaluated using SIL, MLSC, and Peak conditions based on WECC/NERC reliability criteria. Common corridor outages and extreme contingencies were also considered for the year 2008. Also included in this report are the cost estimates for (1) running local generation for RMR; (2) purchasing RMR generation; and (3) upgrading the system so that RMR generation could be eliminated. Information regarding environmental outputs, generator and generation sensitivity, transmission import limit, and alternative solutions is also provided.

Discussion

Base Case Descriptions

All the base cases prepared for this RMR study are from the originally approved Southeast Arizona Transmission Study ("SATS") base cases, with the latest TEP EHV and high voltage ("HV") updates. Peak loads represented in base cases are the planner's best estimate.

February Load Forecast for 2009 - 2019

Year	Load Forecast (MW)	Load Forecast + 5% Load Margin (MW)
2009	2316	2432
2010	2384	2503
2011	2430	2552
2012	2484	2608
2013	2527	2653
2014	2572	2701
2015	2618	2749
2016	2662	2795
2017	2707	2842
2018	2750	2888
2019	2792	2932

Table 2. 2009 Load Forecast for 2009 - 2019

Planned Facilities

TEP planned facilities are documented in the Ten-Year Plan. However, anticipated major system changes between 2010 and 2013 are as follows.

- Tortolita 500/138 kV transformer # 3 with breakers normally open
- Vail 345/138 kV transformer # 3
- New Rosemont load with a new radial 138 kV transmission line from a new switching station on TEP's South to Green Valley 138 kV transmission line
- New Vail – Nogales 138 kV line and conversion of the UNSE system to 138 kV
- Harrison 138/13.8 kV distribution substation
- Craycroft-Barril 138/13.8 kV distribution substation
- Duval Clear 138 kV switchyard
- TEP 138 kV line between Duval Clear and Canoa Ranch substations

Also, the following elements are potentially significant changes between 2013 and 2019.

- Vail 345/138 kV transformer # 4
- Pinal West – Pinal Central 500 kV line
- Pinal Central – Tortolita 500 kV line
- Expansion of the Tortolita substation to include a 500 kV yard and the 3rd 500/138 kV transformer normally in service.
- Spencer 138/13.8 kV distribution substation
- Orange Grove 138/13.8 kV distribution substation
- Hartt 138/13.8 kV distribution substation
- TechPark 138/13.8 kV distribution substation
- Marana 138/13.8 kV distribution substation

- Naranja 138/13.8 kV distribution substation
- Kino 138/13.8 kV distribution substation
- Corona 138/13.8 kV distribution substation
- Anklam 138/13.8 kV distribution substation
- Reconductor North Loop – Rillito 138 kV line
- Reconductor DMP – Northeast 138 kV line
- East Ina 138/13.8 kV distribution substation
- Medina 138/13.8 kV distribution substation
- Raytheon 138/13.8 kV distribution substation
- UA Med 138/13.8 kV distribution substation

Import Transmission Elements for 2010, 2013, and 2019

TEP's import transmission elements are identical for 2010 and 2013. The Pinal Central to Tortolita 500 kV line was added to the 2019 case. Details are shown in Table 3.

Year	From	KV	To	KV	CK	Emergency Rating
2010 & 2013	Saguaro	500	Tortolita	500	1	806 MVA (xfmr)
	Saguaro	500	Tortolita	500	2	806 MVA (xfmr)
	Springerville	345	Vail	345	1	806 MVA (xfmr)
	Winchester	345	Vail	345	1	1110 MVA (1858 Amp - CT/relay)
	Westwing	345	Pinal West	345	1	806 MVA (xfmr)
	Pinal West	500	Pinal West	345	1	806 MVA (xfmr)
2019	Saguaro	500	Tortolita	500	1	806 MVA (xfmr)
	Saguaro	500	Tortolita	500	2	806 MVA (xfmr)
	Springerville	345	Vail	345	1	806 MVA (xfmr)
	Winchester	345	Vail	345	1	1110 MVA (1858 Amp - CT/relay)
	Westwing	345	Pinal West	345	1	806 MVA (xfmr)
	Pinal West	500	Pinal West	345	1	806 MVA (xfmr)
	Pinal Central	500	Tortolita	500	1	806 MVA (xfmr)

Table 3. Import Transmission Elements for 2010, 2013, and 2019

Simultaneous Import Limit for 2010, 2013, and 2019

The load serving capability of the SIL condition is determined without local generation dispatched. As a result, it is less than the forecasted peak loads for those years. Voltage deviation with a ΔV greater than 5% at the Kartchner 115 kV bus of Southwest Transco ("SWTC") is the limit for both 2010 and 2013 SIL conditions for loss of the Winchester – Vail ("WN – VL") 345 kV line. For 2013, however, it is anticipated that the voltage deviation occurs not only at the Kartchner 115 kV bus, but also at the four 230kV buses (Bicknell, New Tucson, Pantano, and Sahuarita), and at three 115 kV buses (Bicknell, Kartchner, and Pantano). The study shows that the ΔV at the Kartchner 115 kV bus is higher than other buses. In addition to the voltage issue, thermal overload is possible on the Apache –

Butterfield ("AP – BT") 230 kV line at 114.9 % of its emergency rating for the same contingency of the WN-VL 345 kV line. Bypassing the series comp of the WN-VL 345 kV line to reduce the flow on this line and tripping Bowie ("BW") units as a local area protection scheme is the mitigation of the voltage deviations and thermal issue for 2013. The Bowie trip cannot be applied to the 2010 case since the Bowie units are not in service until 2013.

The 2019 SIL condition shows that the outage of the WN-VL 345 kV line with the BW trip as a local area protection scheme ("LAPS") causes a voltage deviation at the Unisource Electric, Inc. ("UNS Electric") Valencia 138 kV bus at the loads above 2275 MW. However, bypassing the series comp of the WN-VL 345 kV line alleviates this voltage issue, resulting in a 100 MW higher for the system import limit. The limiting outage identified for the 2019 SIL condition with this bypassed series comp is the Category C contingency of the Pinal West – South and Vail – South 345 kV lines. Loss of these lines causes a voltage dip greater than 10% at the Rosemont and Greaterville 138 kV buses, violating WECC System Performance Criteria. Table 4 summarizes the limiting outage for the SIL conditions at the load levels that have no constraints. Note that SILs were determined based on modeled 25 MW load increments.

Year	System Load (MW)	Local Transmission System Loss (MW)	Total System Condition Value (Load+Loss) (MW)	Limiting Outage	Limiting Element
2010	2175	64	2239	WN-VL 345 kV line	$\Delta V>5\%$ at Kartchner 115 kV bus
2013	1900	48	1948	WN-VL 345 kV line[1]	$\Delta V>5\%$ at Kartchner 115 kV bus
2019	2375	67	2442	PW-SO & VL-SO 345 kV lines	$\Delta V>10\%$ at Rosemont & Greaterville 138 kV buses

Table 4. TEP Limiting Outages of the SIL Conditions for 2010, 2013, and 2019

As required by the Commission, the total system condition value of the 2010 SIL is compared against projected transmission ownership/scheduling rights to Tucson for 2010. TEP's projected scheduling rights to Tucson for 2010 are mainly from the Pinal West – South, Saguaro – Tortolita, and Springerville – Winchester, as presented in Table 5 below.

[1] Agreement in the Bowie Generation Project to trip future Bowie units as a local area protection scheme (LAPS) for loss of the WN-VL 345 kV line results in increased system import limit SIL

Schedules	Scheduling Capability to Tucson (MW)
Pinal West - South	607
Saguaro - Tortolita	110
Springerville - Winchester	1568
Total	**2285**

Table 5. TEP Projected Scheduling Rights to Tucson for 2010

Tables 5 and 6 show that TEP could serve the load with owned scheduling rights since the scheduling capability to Tucson is 46 MW higher than the generation needed under the 2010 SIL condition.

Reliability Must-Run Generation for 2013 and 2019

The RMR generation is determined at the forecasted peak loads for 2013 and 2019 with local generation on-line as necessary. The limiting outage in the 2013 RMR case is also the single outage of the WN-VL 345 kV line that was found in the 2010 and 2013 SIL conditions above. Loss of this line overloads the SWTC AP – BT 230 kV line at 118.5% and Pantano – Butterfield ("PN – BT") at 101.0% of their emergency ratings. At the 2013 SIL condition, this Category B contingency also causes a voltage dip violation at the same SWTC buses with the greatest ΔV at the Kartchner 115 kV bus. All of these issues are mitigated by the BW trip as a LAPS and by bypassing the series comp of the WN-VL 345 kV line, resulting in a lower RMR generation.

The 2019 RMR is thermally limited for loss of the SP-VL 345 kV line; it slightly overloads the North Loop – West Ina (NL-WI) 138 kV line. The RMR generation required to protect against the overload on this line is 30 MW, which is significantly lower than the 2013 RMR. Table 6 presents the RMR of 2013 and 2019.

Year	System Load (MW)	Local Transmission System Loss (MW)	Total System Value (Load+Loss) (MW)	Local Gen/RMR (MW)	Limiting Outage	Limiting Element
2013	2527	65	2592	430[2]	WN-VL 345 kV line[3]	ΔV>5% at Kartchner 115 kV bus
2019	2792	91	2883	30[4]	SP-VL 345 kV line	NL-WI 138 kV line overloaded

Table 6. TEP Limiting Outages of the RMR Condition for 2013 and 2019

[2] Sundt #1 = 75 MW, Sundt #2 = 75 MW, Sundt #3 = 100 MW, Sundt #4 = 125 MW, DMP = 44 MW, Sundt CT #1 = 11 MW

[3] Agreement in the Bowie Generator Project to trip future Bowie units as LAPS for loss of the WN-VL 345 kV results in reduced local generation /RMR

[4] Sundt # 1 = 10 MW, Sundt #2 = 20 MW

Generation Sensitivity Analysis for 2013 and 2019 RMR Conditions

Generation location and volt-ampere ("VAR") outputs drive generation sensitivity. Consequently, different unit combinations could result in different RMR generation, limiting outages and/or elements. In order to minimize operating costs, TEP operates Sundt steam units and gas turbines in the following order of preference:

- Steam units Sundt # 4, # 3, # 2, #1; and then
- Gas turbines at DeMoss Petrie ("DMP") substation, Sundt CT #1 & #2, North Loop CT #1, #2, #3, & #4.

Sundt # 1 is not substituted for Sundt # 2 as a comparison in any combination that includes Sundt # 2 because they are identical and equivalent in cost.

For the 2013 RMR generation sensitivity, the study shows that when Sundt # 3 or # 4 is not available to be dispatched, the voltage deviation at the Kartchner 115 kV bus exceeds 5% for loss of the WN-VL 345 kV line. Therefore, any unit combination that does not include Sundt # 3 or # 4 is not considered an acceptable generation scenario. However, no voltage dip violation is found at this bus when Sundt # 1 or # 2 is not available to be on-line. In all cases (in connection with the loss of the WN-VL 345 kV line), the BW trip and bypassing the series comp on this line are utilized as a legitimate means to mitigate the voltage issue. The 2013 RMR generation sensitivity results are shown in Table 7.

Sundt Unit Combination	Local Generation Dispatched (MW)	Total Local Generation Dispatched (MW)	Limiting Outage	ΔV>5% at Kartchner 115 kV bus
Sundt 1234 **DMP** **Sundt CT 1**	375 44 11	430	WN-VL 345 kV line	No
Sundt 123 **DMP** **Sundt CT 12** **North Loop 1234**	250 44 44 83	421	WN-VL 345 kV line	Yes (all units at maximum)
Sundt 124 **DMP** **Sundt CT 12** **North Loop CT 1234**	275 44 44 83	446	WN-VL 345 kV line	Yes (all units at maximum)
Sundt 134 **DMP** **Sundt CT 12** **North Loop CT 123**	300 44 44 55	443	WN-VL 345 kV line	No

Table 7. Generation Sensitivity for 2013 RMR Condition

For the 2019 RMR condition, the issues identified above are the thermal overloads on the NL-WI 138 kV lines, caused by the single outage of the SP-VL 345 kV line. However, due to the location of generation and/or VAR outputs, the double contingency of the SP-VL and Winchester – Willow ("WN-WL") 345 kV lines also overloads the NL-WI 138 kV line. Furthermore, voltage deviation occurs at the Valencia 138 kV bus for loss of the WN-VL 345 kV line with the legitimate mitigation of the BW trip and bypassing the series comp of this line. The detailed results of the 2019 RMR condition are shown in Table 8 on the following page.

Sundt Unit Combination	Local Generation Dispatched (MW)	Total Local Generation Dispatched (MW)	Limiting Outage	Limiting Element
Sundt 1	65	65	WN-VL 345 kV line	ΔV>5% at Valencia 138 kV bus
Sundt 3 **DMP**	100 22	122	SP-VL & WN-WL 345 kV lines	NL – WI 138 kV line overloaded
Sundt 4	70	70	SP-VL & WN-WL 345 kV lines	NL – WI 138 kV line overloaded
Sundt 12	30	30	SP-VL 345 kV line	NL – WI 138 kV line overloaded
Sundt 13	95	95	SP-VL & WN-WL 345 kV lines	NL – WI 138 kV line overloaded
Sundt 14	30	30	None	None (all units at minimum)
Sundt 34	85	85	SP-VL & WN-WL 345 kV lines	NL – WI 138 kV line overloaded
Sundt 123	85	85	SP-VL & WN-WL 345 kV lines	NL – WI 138 kV line overloaded
Sundt 124	40	40	None	None (all units at minimum)
Sundt 234	45	45	None	None (all units at minimum)
Sundt 1234	55	55	None	None (all units at minimum)

Table 8. Generation Sensitivity for 2019 RMR Condition

Upgrades Needed to Eliminate 2013 and 2019 RMR Generation

TEP could purchase power from market resources instead of running local generation for RMR. This scenario, however, requires transmission upgrades so that TEP could still serve loads and meet the WECC/NERC reliability criteria. When local generation is not on-line for RMR, VARs normally available from local generators are not available and the system heavily relies on the power imports from the Springerville corridor, Westwing – Pinal West-South, and the Saguaro-Tortolita ("SA-TO") corridor, all EHV lines. As a result, loss of the following 345 kV lines, with no local generation operating, results in voltage collapse.

- Pinal West – South
- Springerville – Vail

- Winchester – Vail
- Winchester - Willow

Adding the Pinal Central – Tortolita and the Pinal West – Pinal Central 500 kV lines as well as a static volt-ampere compensation (" SVC") at the Valencia 138 kV bus resolves the voltage stability issue; however, thermal overloads then occur due to both single and double outages. In addition, an SVC at the Kartchner 115 kV bus is required to mitigate the voltage deviations at the Kartchner and Bicknell 115 kV SWTC buses for loss of the WN-VL 345 kV line with the BW trip and series comp of this line bypassed. Therefore, in order to eliminate the 2013 RMR generation and still meet the WECC/NERC reliability criteria, the following upgrades would be needed:

- Accelerating the Pinal Central – Tortolita and the Pinal West – Pinal Central 500 kV projects so that they could be in service in 2013 instead of 2014;
- Adding a second 345/138 kV transformer parallel to the existing one at Vail on the Express Line;
- Adding an SVC at the Valencia 138 kV bus;
- Adding a second Apache – Butterfield 230 kV line parallel to the existing one;
- Adding an SVC at the Kartchner 115 kV bus;
- Increasing the line rating of the Northeast – Rillito 138 kV line to 438 from 370 MVA;
- Increasing the line rating of the DMP – North Loop 138 kV line to 363 from 360 MVA;
- Increasing the line rating of the Vail – Irvington 138 kV line to 426 from 418 MVA;
- Increasing the line rating of the Irvington – RB Wilmot 138 kV line to 323 from 311 MVA; and
- Increasing the line rating of the Vail – RB Wilmot 138 kV line to 358 from 348 MVA.

The cost for the 2013 upgrades listed above would be between $156,568,000 and $197,609,321. For the 2019 case, when there is no local generation/RMR on-line, the study indicates a need of an SVC at the Valencia 138 kV bus to mitigate the voltage deviations at the 138 kV buses such as Canez, Kantor, Sonoita, Valencia, Greaterville and Rosemont, as well as the Kartchner 115 kV bus. Assuming that the Pinal Central – Tortolita 500 kV project and the SVC identified for 2013 are already in service as recommended, there would be no voltage issues, and expenses for the SVC are not included in the estimate for 2019. However, the study also shows that loss of the SP-VL 345 kV line causes an overload on the NL-WI 138 kV line. As a result, the rating of this line needs to be increased to 477 from 369 mega-volt ampere ("MVA"). The cost to upgrade this line is estimated between $1,455,000 and $3,375,600. Table 9 summarizes the cost estimates of the transmission upgrades to eliminate the RMR generation of those years.

Year	RMR Mitigation Cost Estimates	
	Low	High
2013	$156,568,000	$197,609,321
2019	$1,455,000	$3,375,600

Table 9. RMR Mitigation Cost Estimates for 2013 and 2019

RMR Generation versus Purchasing Power plus Transmission Upgrades

In order to compare the cost of running RMR generation for the existing/planned system to the cost of purchasing power from market resources plus the cost of transmission upgrades, the RMR hours, RMR energy, and RMR annual costs have been determined by a TEP cost analyst.

The RMR hours are determined through an hourly comparison of the forecasted retail load to the SIL (MWs). Given an hourly load forecast, all hours above the SIL are identified to be RMR hours. Generation costs were derived for the 2013 and 2019 forecast years that resulted in the estimated amount of RMR generation. The RMR cost estimates are calculated based on the differential between the forecasted hourly on-peak power price ("Palo Verde Price") and the dispatch price ("NYMEX Natural Gas Index") of the Sundt and DMP units.

A production cost analysis was performed to derive the RMR estimate. The model analyzes the hourly load above SIL and applies the appropriate local generation dispatch and calculates a cost comparison to the hourly Palo Verde Price. This methodology represents an hourly estimate between the difference in spot market prices at Palo Verde Price and the RMR dispatch of TEP's gas fired generation. Sundt Unit 4 operates at a high capacity factor due to economics, though it contributes to RMR above SIL. The RMR results are summarized in Table 10.

The methodology in Table 10 represents an hourly estimate between the difference in spot market prices at Palo Verde and the RMR dispatch of TEP's gas fired generation. Since this methodology uses a Palo Verde Price spot market price, it does not factor in market demand charges for generation, transmission wheeling costs, and costs for transmission losses. The additional costs for remote generation would offset some of the annual RMR cost estimate. In 2008, TEP implemented a new production cost model titled "Planning & Risk." This model was developed by Global Energy Decisions ("GED"), and has the capability to model hourly transmission constraints including hourly RMR requirements. TEP utilized the methodology as shown in Table 10 for this RMR study.

	2013	**2019**
SIL	1948	2442
MLSC	2638	3104
Peak Load	2592	2883
RMR Hours	**697**	**252**
RMR MWh	**41,820**	**15,120**
Annual Incremental RMR Generation Costs	**$735,000**	**$0**

Table 10. Incremental Annual RMR Generation Costs for 2013 and 2019

The incremental annual RMR generation cost is $735,000 for 2013 and there is no incremental cost for 2019. The 2019 peak RMR capacity requirement is 30 MW, but as explained above, Sundt 4 would be dispatched economically at a level above 30 MW. The relatively small cost of RMR generation makes upgrading the transmission system to eliminate RMR generation unjustifiable.

Effectiveness and Comparative Analysis of Alternative Solutions

Upgrading the transmission system to eliminate the need for RMR generation is not economically justifiable because the cost of upgrading the system significantly outweighs the cost of running RMR generation. Table 11, on the following page, compares the cost of investment for transmission facilities needed to avoid RMR versus the cost of operating local generation. The economic advantage of running RMR generation is clear.

Cost for:	2013		2019	
	Million $	Million $	Million $	Million $
RMR Mitigation	$ 157	$ 198	$ 1.5	$ 3.4
Incremental Annual RMR Generation	$624		$ 261	

Table 11. RMR Mitigation versus Incremental Annual RMR Generation Cost

RMR Environmental Output Estimates for 2013 and 2019

All of the environmental outputs shown in Tables 12 and 13 below are based on the estimated 2013 and 2019 RMR generation requirements. These tables also include the emissions from Sundt Unit 4 during the RMR hours in which Unit 4 was dispatched economically.

2013 RMR Environmental Output	Estimated SO2	Estimated NOx	Estimated PM	Estimated CO2
Sundt Steam Gas (lbs)	66	22,140	581	13,131,614
Gas Turbines (lbs)	72	3,579	1,137	14,295,510
Sundt Steam Coal (lbs)	146,057	78,213	1,362	36,926,128

Table 12. 2013 RMR Environmental Outputs

2019 RMR Environmental Output	Estimated SO2	Estimated NOx	Estimated PM	Estimated CO2
Sundt Steam Coal (lbs)	124,697	66,775	1,163	31,525,864

Table 13. 2019 RMR Environmental Outputs

Maximum Load Serving Capability for 2010, 2013, and 2019

The MLSC is determined with all local generation on-line less spinning reserve. The MLSC for 2010 and 2019 are thermally limited by the double outages: SA-TO # 1 & # 2 (both 500 kV lines), and PW-SO & VL-SO (both 345 kV lines). The voltage deviation violation at the Kartchner 115 kV bus is still a limit under the 2013 MLSC condition for loss of the WN-VL 345 kV line. Bypassing the series comp of this line and tripping BW are the mitigation of the voltage issue. The study shows that the DeMoss Petrie – Santa Cruz ("DMP-SC") 138 kV line is overloaded when the double outage of SA-TO #1 and #2 happens. The case quits solving while shedding load. Similarly, in the 2019 case, loss of the PW-SO and VL-SO 345 kV lines overloads the Irvington – Drexel ("IR-DX") 138 kV line, which also quits solving while shedding load. Table 14 shows the limiting outages and elements of the MLSC conditions at the load levels that have no constraints.

Year	System Load (MW)	Local Transmission System Loss (MW)	Total System Condition Value (Load+Loss) (MW)	Limiting Outage	Limiting Element
2010	2575	66	2641	SA-TO #1 & #2 500 kV lines	Case quits solving while shedding load for DMP-SC 138 kV line
2013	2575	63	2638	WN-VL 345 kV line with BW trip	$\Delta V > 5\%$ at Kartchner 115 kV bus
2019	3025	79	3104	PW-SO & VL-SO 345 kV lines	Case quits solving while shedding load for IR-DX 138 kV line

Table 14. TEP Limiting Outages and Elements of the MLSC Condition for 2010, 2013, and 2019

Common Corridor Outages for 2010

The common corridor outages studied for 2010 are as follows:

- Springerville – Greenlee and Springerville – Vail 345 kV lines;
- Greenlee – Winchester and Springerville – Vail 345 kV lines; and
- Winchester – Vail and Springerville – Vail 345 kV lines.

TEP's normal operating procedures include the ability to survive these corridor outages via the Tie Open Load Shed scheme. Study results show that TEP can survive these contingencies under the 2010 system condition.

Extreme Contingencies for 2010

The extreme contingencies studied for 2010 are loss of all EHV transformers at any one EHV substation. The substations with TEP EHV transformers are Tortolita, South and Vail. Surviving the loss of all transformers at any single EHV substation is included in TEP's normal operation planning, and study results show that TEP can survive these contingencies under the 2010 system condition.

TEP Local Generating Units Data

Base Loadable	**Min Dispatch (MW)**	**Max Dispatch (MW)**	**Qmin (MVAR)**	**Qmax (MVAR)**
Sundt Unit #1	10	75	-15	80
Sundt Unit #2	10	75	-15	80
Sundt Unit #3	15	105	-15	65
Sundt Unit #4	20	125	-30	120
DMP GT #1*	44	73	-10	47
Peaking	**Min Dispatch (MW)**	**Max Dispatch (MW)**	**Qmin (MVAR)**	**Qmax (MVAR)**
Sundt/Irvington GT #1	22	22	-10	15
Sundt/Irvington GT #2	22	22	-10	15
N. Loop GT #1	22	22	-10	15
N. Loop GT #2	22	22	-10	15
N. Loop GT #3	22	22	-10	15
N. Loop GT #4**	17	22	-5	5

Table 15. TEP Local Generating Units Data